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Cox, Donald Lee, M.S.

Iowa State University, 1991

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A comparative analysis of methods used  
in preparation for occupational testing

by

Donald Lee Cox

A Thesis Submitted to the  
Graduate Faculty in Partial Fulfillment of the  
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MASTER OF SCIENCE

Department: Professional Studies in Education  
Major: Education (Adult Education)

Signature was redacted for privacy.

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Iowa State University  
Ames, Iowa

1991

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## ABSTRACT

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Master of Science Degree - Education  
May, 1991

" A comparative analysis of methods used  
in preparation for occupational testing "

Acceptable and recognized methods utilized to develop competency and prepare for occupational testing are strongly controlled by certifying agencies. Teachers, law enforcement officers, medical personnel and fire fighters, to name a few, operate under specific guidelines for training requirements to qualify for professional certification. Most certification examinations are competency based tests. What methods of preparation a certifying agency recognizes may severely restrict an individual's option to develop competency.

This research thesis specifically investigates fire fighter certification and methods of preparation to develop competency. Over five-hundred Iowa fire fighter candidates from 1989 to 1991 were studied. Written examination scores were collected along with various demographic information.

Specific hypotheses studied involved methods of preparation; years of experience; volunteer vs. career fire fighters; and gender of the candidates.

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## CHAPTER 1. INTRODUCTION

## Background

Acceptable and recognized methods utilized to develop competency and prepare for occupational testing are strongly controlled by certifying agencies. Teachers, law enforcement officers, medical personnel and fire fighters, to name a few, operate under specific guidelines for training or educational requirements to qualify for professional certification. This chapter will discuss the general problem of diverse prerequisite training mandates prior to certification evaluation as a fire fighter. The diversity becomes an issue when there appears to be very little agreement and research on how a candidate for certification may develop competency and ultimately prepare for the examination. This broad perspective will be narrowed to the specific purpose of this study. Research questions will be presented with operational definitions identified. A summary will review the key components of Chapter 1.

In an unpublished survey (Cox, 1990) of 35 states in the United States, the fire fighter certification agency in each state recognized various competency preparation methods ranging from mandated formal classes to correspondence courses. Certain agencies required specific teacher-led classroom work only, while others recognized a variety of alternative methods of preparation. Some states recognized both teacher-



led and self-directed preparation. Of the 35 states surveyed, no two states recognized the same approach to developing competency. Since the majority of the states base their certification standard on national criteria (NFPA 1001, 1987), it would seem logical that some uniformity would exist in recognizing competency training methods.

The National Professional Qualifications System, through an accreditation Board for the fire service (National Board on Fire Service Professional Qualifications Procedures and Criteria, 1990), states that a certifying agency shall "establish and maintain procedures that ensure certification shall be granted to any eligible person who satisfactorily fulfills the qualification irrespective of method, manner, or place in which that person acquired the required skills, abilities or knowledge (p. 6)." Some certifying agencies are violating this competency based qualification and are requiring specific classroom attendance. Other agencies are upholding the criteria but have conducted no research as to which methods are most effective in developing competency.

The Fire Service Institute, at Iowa State University has been certifying Iowa fire fighters since April, 1974. Prior to July, 1989, a mandatory 60-hour course was required to qualify a candidate to take a written examination for qualification. Based on an informal needs assessment and constituency requests, the mandatory training component was removed as

a prequalifying requirement. Various fire departments claimed that they conducted similar or superior training programs that would develop competency and prepare a candidate for the examination. Other departments complained that only one authorized course was too restrictive and occasionally was not available when needed. New Iowa Fire Fighter I certification criteria and procedures were formulated. Specific training was removed as a mandate. The new policy then required a candidate to pass a written and a psycho-motor assessment with a score of 70% or greater correct. Since the Fire Service Institute changed policies to less restrictive prequalifying procedures, a wide variety of candidates with different motivations and preparation approaches could seek certification.

Fire fighter certification, in the State of Iowa, is voluntary. Only a few local communities and larger cities make it a requirement for their fire fighters. Departments that mandate the certification are usually fully-paid, career departments. Candidates must be at least 18 years of age. Since the vast majority of Iowa fire fighters are volunteers and must be legally of adult age, our study has its roots in adult education issues. Many of these adults that choose to seek professional certification do so on their own free will. These potential fire fighter candidates then select the method that best suits their needs to prepare for the exam. Some are

guided into formal department training programs while others may study at home and practice at the fire station under the supervision of peers or fire officers. Further exploration of adult education and the implications it has on this study will be discussed in Chapter 2. Fire fighter candidates in Iowa come from a varied background and with new certification procedures established a number of various research variables can be investigated.

Although fire fighter certification in the State of Iowa consists of a written examination and a psycho-motor test, this study investigated only the written examination scores as a dependent variable. The psycho-motor test, while extremely important to the overall certification evaluation, has too many moderating variables present to be part of this study. This psycho-motor portion of the exam could potentially provide interesting insight in future studies. Certification under the previous system with a required course did not test a candidate's physical psycho-motor skill. The intent of the new psycho-motor test is to insure a candidate can adequately perform fireground activities and has learned more than the didactic, knowledge material. Without some type of assessment of a candidate's ability to use tools and equipment, it is conceivable that the candidate can learn the written material and pass a certification evaluation without ever turning on a fire hydrant. That is not possible with the Iowa system of

fire fighter certification. The whole issue of skill testing in occupational evaluations is an intriguing thought for future research.

#### Statement of Problem

A nationally recognized fire fighter qualification standard exists that identifies specific criteria that should be obtained in order to be a fire fighter. This standard, the National Fire Protection Association (NFPA) 1001 - Professional Fire Fighter Qualifications, does not identify a training component. It states that the standard's intent was to develop "performance standards in such a clear and concise manner that they can be used to determine, without a doubt, that any person so measured does truly possess the skills to be a fire fighter (p. 1)."

A person desiring to become a certified fire fighter must first become competent before they can be evaluated for certification. Various state certifying agencies have adopted the (NFPA) standard as the criteria necessary to become certified as a fire fighter in each particular state. The standard further states that "...the local or state training program shall establish the instructional priority and the training program content to prepare individuals to meet the performance objectives (p. 5)." Each state has the authority to decide how a candidate prepares and trains to meet their certifica-

tion criteria. Since around 1980, a proliferation of study material based on national fire fighter standards have been distributed. These study materials include self-instruction workbooks, video tapes, satellite training programs and prepared teaching kits to name just a few. The Fire Service Institute (Iowa) has prepared and distributed a certification study guide to aid the self-directed learner in preparing for certification. The guide lists suggested methods of developing competency and identifies all written and psycho-motor objectives. In summary, the Iowa State University Fire Service Institute began to formally recognize alternative methods to prepare for certification evaluations.

Unfortunately, even with a wide variety of preparatory methods available there still does not exist adequate research on how a candidate should develop competency in order to be adequately trained for the certification evaluation. The result is that some state certifying agencies mandate specific structured class work while others allow a variety of preparatory methods of training. While self-study options are absent from many certifying agency requirements, it appears that there is some reluctance to accept this preparatory method as a viable alternative. Since certifying agencies establish procedures that set forth competency training and preparation requirements, we must identify what preparatory methods are statistically and practically significant. The certifying

agencies, that are limiting their candidates to one mandated method, may then realize that successful training alternatives exist.

### Definitions

#### Adult Learner

The issue of what constitutes an adult learner, regardless of age, seems to be continually debated. For the purpose of this study, an adult learner is a person who is at least eighteen years of age and engages in some type of activity, formal or informal, in the acquisition of knowledge or skill, in an examination of personal attitudes, or in the mastery of behavior (Hiemstra, 1976).

#### Candidate

A candidate is an applicant who has filed for certification as a fire fighter in the State of Iowa. The candidate must be a member of an Iowa fire department and have access to fire fighting equipment for training purposes. Certification is not mandatory to become a fire fighter in the State of Iowa although some local jurisdictions may require certification of their fire fighters.

#### Competency

Competency is a possession of knowledge, skills and judgment needed to perform an indicated objective satisfactorily.

### Fire Fighter I

Fire Fighter I is the first level of fire fighter certification. It is one of three progressive fire fighter certification levels.

### NFPA 1001

NFPA 1001, Fire Fighter Professional Qualifications (1987) is a nationally recognized standard published by the National Fire Protection Association.

### Structured Learning Experience

Formal training programs led by a qualified instructor in an identifiable learning environment (institution sponsored) with specific educational objectives established.

### Self-Study

A course of study chosen by the individual that allows him or her to pursue their learning is a self-paced, self-directed method.

### Research Questions

The key question asks whether there is a difference in test scores when structured learning experiences are compared to self-study experiences. The assumption is made that the higher the exam score, the more competent is the candidate. Other specific questions are:

1. What specific methods of competency training and preparation are effective if the short term goal is to pass the certification exam through competency?
2. What role does experience play in a candidate's score?
3. Do volunteer fire fighters score differently than candidates that are full-time career fire fighters?
4. Is there a difference in scores due to gender?

#### Assumptions

Two primary assumptions (Brookfield, 1986) of andragogy underpin this study. First, "the exercise of autonomous self-direction in learning" is proposed as a distinguishing characteristic of adult learning. With a variety of methods now available to Iowa fire fighter candidates, various methods of developing competency will be sought out by the adult learner. It is assumed that the candidates prefer this control over how they select to become competent. This freedom to learn then results in a candidate choosing the method that best suits their learning style. A second assumption recognizes the use of personal experience as a learning resource. It is assumed that experienced fire fighters have developed some competency. This experience is also assumed to affect test score results because it is a recognized component in various adult learning models. The candidate would then select the most appropriate method of preparation based upon



past experiences. These assumptions will be further explored in Chapter 2.

### Hypotheses

#### Hypothesis 1A

There will be no significant ( $p \leq .05$ ) differences in Fire Fighter I written examination scores when comparing structured learning against self-study preparation.

Candidates taking the fire fighter certification examination are adult learners. Adult learners have the resources to acquire new knowledge and become competent through use of self-study learning as an alternative to participating in an adult formal learning environment. Numerous options to the classroom now exist that offer an opportunity to develop competency toward fire fighter knowledge and skill. It is believed that because of widespread usage and popularity of video tapes, study guides, and textbooks, candidates using these methods will have similar test results when compared to candidates that have learned via structured learning methods.

#### Hypothesis 1B

There will be significant ( $p \leq .05$ ) differences in Fire Fighter I written examination scores when comparing specific methods of preparation selected by the candidate.

Although in Hypothesis 1A, it is proposed that there is no difference in test scores within the broad categories of

self-study vs. structured learning, when specific methods are examined there will be a difference. Within this study, three self-study methods and three different structured learning experiences are identified. Because of the potential quality difference in those types of experiences, the author believes a difference will emerge.

### Hypothesis 2A

There will be a significant ( $p \leq .05$ ) difference in Fire Fighter I written examination scores when compared with years of experience as a fire fighter.

It seems logical that fire fighters with more experience would perform better than less experienced fire fighters. A longer period of time to develop competency and refine skills would be available to the experienced fire fighter. Fire fighters with more experience have normally been exposed to more training sessions related to basic entry level criteria. Experienced fire fighters normally have had the opportunity to utilize learned skills on the emergency scene. Another factor that may affect experience and competence is that the experienced fire fighter possibly begins to realize the relevance of the subject material and ultimately places more value on that knowledge. In contrast, it is the author's observation that the more experienced candidate is less "motivated" to prepare and review the testing criteria. The less experienced candi-

date is often motivated by future job prospects and their training is concentrated in the basic fundamental material while the experienced candidate often develops specialities or is distracted by other educational subjects.

### Hypothesis 3A

There will be a significant ( $p \leq .05$ ) difference in Fire Fighter I written examination scores between members of fully paid, career departments and members of fully volunteer fire departments.

Specifically, evaluating the amount of training and utilization of skills, the career fire fighter generally has more opportunity to practice essential skills. This continual practice and reinforced learning is assumed to enhance ability. Further, there exists a segregation of volunteer fire fighters and career fire fighters. Separate organizations exist for the two entities with little communication taking place between the two. Paid fire chiefs have a different organization from volunteer fire chiefs. Career fire fighters typically are unionized while volunteers belong to a different volunteer professional association. Does this apparent "difference" also exist in occupational testing results?

#### Hypothesis 4A

There will be no significant ( $p \leq .05$ ) difference in Fire Fighter I written examination scores based on gender of the candidates.

The rationale is that female candidates are equally capable of learning fire fighting skills as males. Statistics (Darkenwald & Merriam, 1982) indicate significant changes in the proportion of women enrolled in occupational training. From 1969 to 1975, 29% of the total male population surveyed participated in some form of occupational training. That proportion remained steady throughout the six year period. In comparison, female participation in occupational training increased 25% during the same period. With such an increase of women in occupational training, it is apparent that more women are interested in occupational training and may ultimately enter professions that require testing such as the fire service. It is the author's observation, in the fire fighting profession, that many continue to question whether women belong in this particular occupation. Few critics of this issue have addressed the question in relation to specific performance evaluations. If women can be shown to be equally competent in fire fighting knowledge and ability, then why not encourage more female participation. There is no reason to believe that there would be a difference in cognitive fire fighting knowledge based on gender. No research was discov-

ered that evaluates fire fighter test results and gender. Although some fire departments appear to need more females, less than 10% (Hansen, 1990) of the fire fighters in Iowa are currently female. If traditions of a male dominated work force are to be changed, legitimate data seem necessary. Volunteer fire chiefs frequently complain that it is difficult to maintain a volunteer force in today's society while at the same time are limiting their recruitment to the male gender.

#### Significance

Regarding methods of preparation, if expected results are not met, program reexamination may be in order. For example, if a candidate primarily studying via structured learning is scoring significantly better than self-study methods, what may be creating the difference? Is there something wrong with self-study methods or is a rigid fire department training program a better environment to develop fire fighter competency? If expected results are met, further research may be necessary to compare studies in order for certifying agencies to consider recognizing alternative methods of preparation as viable options.

This issue of experience as a means of preparation and competency building may result in a new perspective of occupational testing and recertification needs. If test results indicate fire fighter score lower with experience, what can be

done to ensure their ability is maintained and possibly enhanced?

When an emergency arises, the general public expects to be protected proficiently by a fire department regardless of whether it is a volunteer or career department. If a significant difference in cognitive knowledge exists between career and volunteer fire fighters what possible implications does that have for the general public?

In order to illustrate equal abilities among men and women in the fire service, a good beginning point is to evaluate cognitive abilities related to fire fighting.

#### Summary

This chapter identifies the reason the researcher chose preparation for occupational testing as a topic. Additionally, the potential benefits derived from such a study were discussed. Results could affect other fire professionals as well as any profession that offers occupational testing. A historical perspective implies that new opportunities are available for adults to learn fire fighting knowledge and skills. Next, a discussion centered around Iowa State University's Fire Service Institute change in policy that began to recognize forms of preparation other than formal structured learning environments. But before we begin to readily accept various methods as viable, we must first

evaluate their effectiveness. Specific questions were posed with five questions being formulated into research hypotheses. Results of the research hypotheses will assist us in understanding what effect different methods of preparation have on certification evaluations for fire fighters in Iowa. Additional demographic comparisons will guide us toward further studies.

The goal of this study was to compare test scores of an alternative approach to the rigid formal training course requirement as well as other demographics that may affect test scores. Suggestions are offered for recognizing what preparation method(s) appear most helpful.

The following questions were of particular interest to the study:

1. Should the Fire Service Institute or other similar certifying agencies continue, and in some cases begin, to accept alternative methods of preparation?
2. Do certain demographics appear to result in better test scores?

## CHAPTER 2. REVIEW OF LITERATURE

### Introduction

This chapter will explore various theories, philosophies, research and conceptual ideas found in the literature related to methods of delivering adult learning. The first section discusses broad issues centered around what we know about conditions related to adult learning and then begins to focus on planning methods, techniques, and materials. The second portion of the literature review will discuss job experience as a variable in adult learning and testing. Lastly, the third section will identify specific research conducted that is related to various learning methods in adult education and preparation for occupational testing.

### Theoretical Framework--Adult Learning

For most allied service professionals, test performance is critical in certification requirements. Methods to assist candidates in effective preparation for their occupational competency and ultimate certification test should be of interest to educators, certifying agencies and the candidates themselves. How a person learns is what should guide how a person is trained (Muchinsky, 1990). Traditional education such as a structured institutional course, is subject centered. Often times the learner's prior experiences and current personal goals are not considered in planning the



learning process. Knowledge is simply disseminated from one source toward another. Nontraditional education such as self-study, self-pacing, self-directed or independent learning are commonly linked by being learner centered. Nontraditional education (Lenz, 1982) attempts to facilitate a positive change in the learner rather than simply advancing a particular discipline. The learner often times assists or totally plans and organizes the learning experience. Individual goals, objectives and life experiences can be structured into the learning environment.

#### Conditions For Learning--Needs, Experience, and the Environment

Various theories founded on experience and research indicate certain conditions in which adults learn more effectively. In the Adult Perspective (1989), three conditions are identified as being critical. First, the person needs to participate in the process of diagnosing needs. Learners are more committed to the goal when they participate in deciding what to learn and how to learn. Involvement of the learner (Boyle, 1981) is a key ingredient in adult education planning, implementation, and evaluation. Decision making by adults toward their educational planning should offer "alternatives based on information, rules and specific criteria (p. 112)." It is the role of adult educators to offer such

alternatives and help guide the learner toward an effective match based on desired goals or learning criteria. Boyle (1981) suggests that once a decision is made, "implementing alternatives, reflecting and/or recycling" may become necessary for the learner (p. 112). Leaving a learner with only one approach to understanding something new in life ignores our individual identity and unique learning needs. Transactional encounters (Brookfield, 1986) that promote intrinsic interest for the learner will circumvent the banking system some educators still practice. Learning which involves a true internal mental change along with a permanent behavioral change indicates the encounter was effective. Involving adults in their educational planning and offering alternatives helps create a motivational environment that can recognize individual needs. Darkenwald & Merriam (1982) in reviewing Carl Roger's theory on self-directed learning identified that "emphasis upon self-initiated learning is relevant to the learner, and the idea of student participation in planning and evaluating learning has served as a model for adult educators (p. 80)." In discussing a learner's goals and needs, Cross (1981) stated that a self-directed learner that has confidence that s/he can develop the knowledge or skill required for the job promotion is motivated by knowing that achievement can be "certified." In comparison, the learner who lacks the self-confidence but knows certification

is possible, will need a tutor or some other form of help to learn the task.

A second critical condition (Adult Perspective, 1989) is met when the learner's unique experiences are part of the learning process. Being able to relate what they learn to their own experiences helps complete a key component in effective learning. Prior experiences also help formulate a person's developmental level.

Knowing a person's developmental level can aid in the selection of specific educational methods. An important aspect of assisting professionals seeking certification, licensure, or promotion through occupational testing is to evaluate the developmental focus of the individual (Chickering, 1975). By identifying a person's motive and education experience, their learning ability can potentially be enhanced. The motives and experiences of a twenty-five year old seeking their first occupation may be different from a forty-five year old deciding to change jobs and career direction. The potential problem with institutions and conventional classroom settings, is that they "pitch to only one or two developmental levels, although their students span the full range" (p. 203). Chickering (1975) points out that certain people in a specific developmental stage may benefit from certain types of teaching practices. Learners in a self-protective or conformist ego development need teacher-

led type learning. In comparison, conscientious and autonomous learners can effectively utilize programmed learning, correspondence study or contract learning to enhance their development and understanding.

One of Malcolm Knowles' (1989) thirteen "Principles of Adult Teaching," is "learning should be related to and, should make use of the student's experience (p. 76)." Learning as a process (Wilson, 1989) incorporates past, present, and future life experiences. Our retention system of the past assists our present learning by transferring previous experience into our current cognitive process. The probability realm of future goals and context transposes additionally to the present learning activity. Through differentiating, structuring, and integrating the three realms of learning, abstractions may be drawn to help us understand what it is we want to learn. If we can finally generalize and draw conclusions about our experience, learning has happened. Learning that is void of past and future realms would appear to limit the totality of the experience for the learner. When learning is facilitated and guided by another adult, each participant's individual experience should be evaluated and incorporated into the learning situation as appropriate.

The last condition to enhance adult learning (Adult Perspective) is proper establishment of the learning environment. The physical setting as well as the psychological

climate are important. Being comfortable when we learn minimizes distracting interferences. The physical setting has numerous factors that can affect the learning environment. Room arrangements, lighting, ventilation, and instructional audio/visual aids are just a few of the many factors that can impact the setting. The psychological climate includes the consideration of an atmosphere founded in trust and cooperation.

Adults allowed to proceed at their own pace and given adequate time for problem solving will more easily reach their learning goals. A variety of approaches exist that can assist the learner once needs are assessed and experience is recognized and blended into the learning process. Wilson (1983) identifies the importance of knowing "when to do what, with whom, and why (p. 103)." He identifies a variety of material available that can potentially facilitate learning. The main purpose of instructional material is to assist the learner toward internalizing the new experience. Learning material ranges from a very sophisticated electronic classroom to simple self-study guides. Materials are often matched to method by identifying the client. In individual settings it is possible to use self-directed study or correspondence type material. When groups are present in a learning situation, exercises, interactive lecture, or role-playing may be effective. In large audiences, lecture or video

tape presentations may be the mode of operation. The goal of the learner is also an integral part of discovering an effective learner match between methods and materials. Is the goal personal, social or cultural? Different options and orientations exist. The learner and/or instructor can create or select their own educational materials based on preferred methods and learning goals.

In summary, when one considers the learner needs, experience and the learning environment, it would seem beneficial for the learner to be involved in establishing the learning situation. By offering a variety of options to select from, the learner has an opportunity to choose what is best suited for him/her. "Learners involved in creating their learning experience have greater satisfaction with the experience, show greater achievement, make better decisions, show increased commitment to the program, and develop more realistic expectations of what they can get out of the program (Wilson, 1979, p.7)."

#### Studies of Job Experience and Occupational Testing

Experience of an employee can have an impact on test results as pointed out by Muchinsky in studies comparing job applicants against current employees (Muchinsky, 1990). One problem is that employees who are secure in their jobs are less motivated to do well on the test than ambitious appli-

cants who need the job. Applicant's scores can be higher than the employee's scores.

In some well-known studies conducted by Harold Rothe (1947; Rothe & MacMillian, 1948), current employees were given an exam to develop a performance base in order to establish employment testing. As a general rule, "there was an understanding that no one's job status would suffer as a consequence of their test results and that taking the test for validation purposes was on a voluntary basis (p. 480)." Rothe discovered that a critical score that would have eliminated about 40% of the current employees from their jobs, would disqualify about 15% of the job applicants. Discussion of the weak performance by experienced employees identified incentive as an independent variable. The person seeking employment could possibly be driven to perform better because of their desire to be hired. Current employees could be viewed as having nothing to lose. It was also identified that experienced employees may have the tendency to "read into" the question, thus making it more complicated than it was. During this occupational testing research, it appeared that "greater test-taking incentivization of applicants accounted for the shifted distribution of scores (p. 483)." Could experience be a detriment to occupational test scores?

In summary, we know that job experience can have an affect on occupational testing. We know that the work force

can have a wide diversity of experience and conduct basically the same job. A fire fighter may have less than one year of experience and be found working alongside another fire fighter with thirty years of experience. In this case, what we do not know is if a difference exists, based on experience, in the knowledge levels of those performing the job.

#### Research Studies Analyzing Methods of Preparation

A wide variety of methods in adult learning exist. Equally a number of research studies have evaluated the effectiveness, practicality and popularity of alternative methods in learning.

Technology and the beginning of an information age inhabited with children raised by television sets has made numerous programs readily available. Books on tape, foreign language lessons via cassette tapes, satellite down-links, video-taped lectures and interactive video are just a few that have gained interest among learners that seem too rushed to sit in a classroom for 40 hours.

Traditional methods in education of classroom lecture and the dissemination of knowledge through "banking" methods has existed for many years. A challenge to this tradition in the form of self-directed learning has surfaced with various philosophies and theories. Self-directed learning (Haughton



& Dickinson, 1988) is a process which "encourages the learner and develops the learner's capacity for his/her own learning (p. 233)." A self-directed learner becomes one "who is aware of the variety of ways and means of learning which are available and who is capable of organizing himself or herself to accomplish that learning (p.234)."

In a study conducted at Ohio State University College of Medicine (Sacks et al., 1985), researchers compared more than 2,000 students over a 10 year period that participated in an independent study program or a more traditional program. The research investigated their preparation method and scores on the National Board of Medical Examiners (NBME) examination. A random assignment of students to the two preparation methods was utilized. The same program content was found in the independent study program (ISP) as the conventional-lecture-discussion program (LDP). In addition to the analysis of their test scores, researchers investigated the students' performance in required clinical clerkship. The two preparation methods adjusted score means on their NBME tests were identical. Adjustment entailed taking into account their GPA and Medical College Admissions Test scores. Performance in their required clerkship also illustrated no difference in overall performance. There were specific curriculum areas where one group scored differently than the others which caused the College to revise its curriculum in the area

showing lower scores. Both programs experienced improvement while the College of Medicine gained support to continue both programs of study and offer alternative methods of preparation to the students.

The use of media in instruction has been well documented (Twetten, 1988). No solid data appear to link a cause and effect relationship to liking the method of television instruction and learning. A host of moderating variables seem to exist when conducting such research. In a study of 400 research comparisons (Kulik & Kulik, 1979) made between televised and conventional teaching, there was no significant difference in student achievement. Specific and limited use of television to certain programs appears evident. For teacher training, the use of television to view modeling protocol is useful. Teacher mannerisms and techniques can be played back and reviewed for critique.

Interactive video now allows the participant to intervene in the action and proceed at a pace determined by the learner. Instant feedback on progress also reinforces adult learning concepts. According to Twetten (1988) in a meta analysis conducted between 1978 through 1986 interactive video produced increased learning as compared to traditional instruction.

Concerning alternative methods of preparation, Pazdernik & Walaszek, (1983) compared test scores of students who pre-

pared through lecture and laboratory settings to students who learned material via computer-assisted instruction (CAI). A growing interest in the use of computers in medical education prompted the University of Kansas to develop an alternative approach to the conventional method of learning basic pharmacology. It is interesting to view the program's five major objectives because of their implications in adult learning:

1. Pharmacology courses needed to be available at any time throughout the year.
2. Programs were needed that could handle students with various levels of preparation.
3. Students could be self-paced and progress through the course at various speeds.
4. The system would provide frequent and rapid feedback to both the student and instructor.
5. The program could utilize newer educational technology and techniques that offered flexibility.

One weakness noted in the conventional lecture format was that students had to "assimilate enormous amounts of material at the same pace (p. 343)." One unwritten benefit of the CAI program was that it encouraged students to develop independent study habits that are essential in a career in health sciences. If true life-long learning is to occur, we must provide independent study guides and promote programs that teach learners how to learn. The study resulted in 16,000

responses from University of Kansas students taking pharmacology exams. Those utilizing the CAI program of preparation scored 81% correct answers while those using other methods scored 68% correct answers. Another evaluation of CAI comes from the University of Hawaii John A. Burns School of Medicine. Student scores on the National Board of Medical Examiners examinations raised their mean score of 485 in 1973 to a mean score of 625 in 1976. Pazdernik and Walaszek best sum up their study of computers used as a preparatory method by identifying that it "allows students to select the educational approach best suited to them, and the system is based on concepts that no two students derive the same benefit from any single educational technique and that students vary greatly in the rate at which they assimilate material (p. 347)." Serious attention must be given to developing alternative methods of preparation, training and education. The technology of today far exceeds the confines of classroom walls.

A study investigating the relationship between medical certification examinations and in-training examinations (Biestler, 1985) revealed some potential moderator variables in occupational testing. The study examined the relationship between the American Board of Surgery's In-Training Examination and its Qualifying Examination. Seven hundred sixty-four candidates were analyzed in the 1982 study. Similar to

other occupations, one of the goals of the occupational test was to "provide a clear demonstration of each (resident's) competence (p. 1)." The In-Training Examination was a formative evaluation approach used to help guide a student during their training program. The medical student's primary method of training is in a structured learning environment of classroom didactics and clinical practice. A written examination was used in this assessment. After data analysis resulted in low correlation between training tests and certification exams, Biester speculated that one cause might be a candidate's motivation to prepare for the training exam. A survey conducted concerning preparation indicated that 51% actively studied prior to test administration. The motivation for taking occupational exams could be as varied as the people taking them. Can various motivational levels be partially accountable for score outcomes? Although not part of the current study we are conducting, it appears that it is not a variable that should be entirely dismissed.

### Conclusions

It is apparent in this literature review of current adult education concepts that program planning and educational delivery should recognize and incorporate an individual's prior experience and current needs into the learning environment. Occupational training and certification that ignore

these fundamental concepts may be missing valuable contributions a learner possesses. Specific research indicates that numerous approaches to developing occupational competency exist. The fire fighter certification process in the State of Iowa recently changed policies to reflect the recognition of alternative approaches to developing competency. What we do not know is how these changes have affected examination results and what implications should be considered by similar certifying agencies.

## CHAPTER 3. METHODOLOGY

### Introduction

This chapter describes and discusses the research methodology. It identifies the nature of the study, the population, instrument, data collection procedures and research design. The reliability and validity of the written examination is discussed. The survey used to compile demographic data is described and illustrated (Appendix A). The potential limitations of data collected are also reviewed.

### Design of the Study

The study was directed by survey research techniques as well as written examination results. The examination results were recorded as a percentage correct. A survey questionnaire was used to collect data pertaining to a variety of demographic information. These data are reported as frequencies and percentages. The questionnaire provides data for exploring a number of different variables and their possible relationship between each other in addition to comparing them to the candidate's examination score. A static group comparison research design was employed in the study. This allowed the researcher to evaluate the potential effects certain variables may have on developing competency and ultimately passing the fire fighter certification examination. Because we cannot be sure that the various groups

are equal in all respects that may influence their test scores, the research design is classified as preexperimental. The assumption is made that the study's groups are equivalent in all aspects related to their test score achievement and differ only in their exposure to the independent variable being examined. Unequivocal causation is not implied in any of the research results or conclusions.

### Instrument

Written examination scores were analyzed by various demographic factors. The demographic information was collected through the use of a survey questionnaire just prior to the certification examination. The psycho-motor evaluation portion of the certification examination is not included in the study because of the lack of control and questionable reliability in the subjective evaluations. Random skills are selected for each candidate and different skill evaluators are used which could potentially affect consistent results on the psycho-motor tests.

The written examination and survey questionnaire are described in detail for possible future replication.

Written Examination. The dependent variable is the written test score which is the percentage of questions answered correctly on a 100 question multiple choice and true/false certification exam. There is no time limit placed



on the candidate to complete the exam. The mean score of the examination is used as the statistical datum. Seventy percent or greater correct is a passing score.

The Iowa Fire Fighter I certification examination is a criterion referenced examination. The validity of the examination is found within the established criteria derived from NFPA 1001 (NFPA, 1987). There is a written test question for each objective stated in the standard. There are seventeen categorical areas, which include:

- General Knowledge
- Fire Alarm & Communication
- Emergency Medical Service
- Fire Behavior
- Self-Contained Breathing Apparatus
- Forcible Entry
- Ventilation
- Ropes
- Rescue
- Safety
- Ladders
- Fire Hose, Nozzles and Appliances
- Fire Streams
- Sprinklers
- Salvage
- Overhaul
- Inspection

Each of the standard's knowledge and skill items were written in an educational objective format. The audience, behavior, conditions and degree are all described for the candidate. The written examination insures that there is an examination question for every item in the standard, based on the national criteria.

Reliability and Validity. The reliability of the examination is founded on the basis that the criterion-referenced mastery test provides consistent measurement (Gronlund, 1985). Internal consistency is important, which measures one item to another, when all the items measure the same learning outcome. The stability is equally important which from one time to another, the learning outcomes are expected to have a reasonable degree of constancy. Since two forms of the exam are given, we would expect to see consistent results from one form to the next which measures equivalence. A t-test was used to compare test version "A" against test version "B". No significant difference was found at the .05 level of significance. In order to measure internal consistency the Kuder-Richardson Formula 20 reliability for the "A" version of the examination was estimated to be 0.88. The "B" version reliability estimate was 0.82.

Criterion-referenced mastery tests are different from norm referenced exams in the fact that the criterion-referenced exam is "not designed to emphasize differences among individuals (Gronlund, 1985)." In fact, if preparation has been highly successful, we would expect to witness scores being clustered near the top of the scale. Because of these differences it is not suggested we use similar equations as used for norm referenced examinations. In mastery testing we are mainly interested in viewing the mastery-nonmastery

relationship. In this case, it is based upon a 70% passing score.

Survey Questionnaire. The questionnaire (Appendix A) identifies the independent variables in discrete categories. The questions pertaining to this study are highlighted below.

Hypothesis 1A uses data from question "K" as a primary method of preparation for the examination. One independent variable the candidate can identify as a method of preparation is that they "did not study" before taking the exam. This variable was not included in Hypothesis 1A because it does not appear to belong in either the structured learning or self-study group. The candidates that chose one of the other six options are used. Three of those options are combined and described as structured learning experience" while three others are combined as a self-study method. Structured learning experience is grouped as either an Iowa Fire Service Institute course, community college course, or a fire department training program. In general, it may be any formal training program led by a qualified instructor with specific educational objectives established to help prepare a candidate for the Fire Fighter I certification evaluation. The other category grouped as a self-study method is identified as using International Fire Service Training Manuals (IFSTA), IFSTA video tapes or self-study

using materials other than IFSTA materials. The IFSTA materials were the resource for formulating certification test questions. A prescribed method of preparation is not considered a self-study. Candidates could choose to identify only one method of preparation as the primary method. It is possible that a candidate used a combination of preparatory methods. There were no accurate measurements of the quality of self-study methods or structured learning preparation. A wide quality range could potentially skew the results.

In Hypothesis 1B the same question data are used, in addition to those that indicated they did not study. The methods of preparation are left as seven discrete variables to compare against each other.

Total years of fire service experience is collected from the questionnaire for Hypothesis 2A. Seven separate discrete categories are available to select from in question "M". Every candidate must have been an active member of a fire department.

Hypothesis 3A views the data from question "L". Only frequencies of candidates identified as a career member of a fully paid department or a member of a volunteer department are analyzed.

In order to obtain information relevant to Hypothesis 4A, the candidates are simply asked whether they are male or female on the questionnaire.

### Subjects

The subjects in the study included every Iowa Fire Fighter I candidate taking the certification examination between September 27, 1989 and February 16, 1991. Each candidate completed the survey questionnaire and written examination. The total number of subjects was five hundred and nineteen Iowa fire fighters. Participation in the certification evaluation is voluntary in the State of Iowa although some fire departments mandate personnel take the examination. For a \$20.00 fee, a candidate is allowed to take the examination three separate times before a new application and fee must be submitted. In order to avoid an examination score bias, the subjects of this study include only first attempt candidates. The scores of candidates repeating the examination are not included in the data.

A limitation to the study may be the fact that candidates must be a member of an Iowa fire department, and practice all psycho-motor skills before taking the examination. This limits the "civilian" from taking the exam, but offers an opportunity for fire fighters to have access to tutorial assistance. In fact, practice of the skills must be witnessed by two other members of the fire department. A wide range of experience exists among the candidates.

### Data Collection Procedures

The Iowa Fire Fighter I Certification examination is given in local fire departments across the State of Iowa throughout the year. These regional exam locations are established six months in advance and announced to all fire departments in the area. At the test location and just prior to taking the examination, the candidates were asked to complete the survey questionnaire. Each candidate was informed of the research purpose of the information collected and told that their individual identity would not be revealed in any study related to the survey results. The Human Subjects Review Committee at Iowa State University reviewed the survey instrument and procedures related to the candidates' informed consent and individual identity protection. Approval to utilize the survey instrument was subsequently granted. The Iowa State University Testing and Evaluation Center scanned the written examination for survey results and examination scores. The data were then analyzed using a Statistical Package for the Social Sciences program (SPSSx).

### Analysis of Data

The level of significance was established at the 0.05 level. Therefore, any differences at the 0.05 level and beyond will be considered statistically significant.

An analysis of variance (ANOVA) was used to measure observed differences among groups. When only two means were evaluated, a t-test was employed to analyze the data.

Research design is illustrated by Table 1.

Table 1. Research hypotheses, variables and statistical procedures.

Hypothesis	Variables	Analysis
	Dep./Ind.Var.	
	Dep.: Test Score	
1A	Independents: 1) Structured Experience (3 methods) 2) Self-study (3 methods)	T-test
	Dep.: Test Score	
1B	Independents: 1) Did Not Study 2) ISU-FSI Course 3) Comm. College 4) F.D. Training 5) Manual-Self 6) IFSTA Videos 7) Self-study using other materials	One-Way Analysis of Variance Tukey (groups)
	Dep.: Test Score	
2A	Independents: Years of Experience 1) Less than 1 year 2) 1-2 years 3) 3-5 years 4) 6-9 years 5) 10-15 years 6) 16-25 years 7) More than 25 years	One-Way Analysis of Variance Tukey (groups)

Table 1 con't. Research hypotheses, variables and statistical procedures.

Hypothesis	Variables	Analysis
	Dep./Ind.Var.	
3A	Dep.: Test Score Independents: 1) Career Fire Fighter 2) Volunteer Fire Fighters	T-Test
4A	Dep.: Test Score Independents: 1) Male 2) Female	T-test

#### Summary

Five hundred nineteen Iowa Fire Fighter I candidates over a one and one-half year period represent the sample of the study. A dependent variable of their written examination score was compared to various independent variables. Data compiled for the independent variables are derived from a survey questionnaire conducted at the examination location. Research methodology assisted the researcher in analyzing the results by parametric, inferential statistics. The primary hypothesis used a t-test to compare self-study and structured learning. Specific methods of preparation were analyzed using ANOVA techniques. Years of experience categories were compared by mean test scores also using an analysis of variance. T-Tests were conducted for the last two hypotheses related to gender and fire department affiliation.



## CHAPTER 4. PRESENTATION AND DISCUSSION OF FINDINGS

### Overview

This chapter contains the statistical results of the data analyses proposed in Chapter 3. With each research question, descriptive statistics are identified, followed by inferential statistical findings. Tables for each question were prepared to gain a better understanding of the results. The findings are organized around each of the hypotheses proposed earlier. A summary concludes the chapter.

### Demographics

Data collection took place between September 27, 1989 and February 16, 1991. Surveys and examinations were conducted throughout the state of Iowa during this time. The total number of Fire Fighter I candidates tested was five-hundred and nineteen. All candidates completed the survey with no missing values. The mean score on the written examination was 78.38 % accuracy. The majority of the candidates functioned in the position of fire fighter with an Iowa fire department. Three-hundred sixty-seven of the candidates at the time held the position of fire fighter in their department. Fire officers made up 17.1 % of the study group. Fifty-seven percent of the candidates had five years or less of experience in the fire service. The most frequent experience category of candidates taking the examination was

the category with three to five years of experience as a fire fighter. Of all the candidates tested, 14.8% fell below the 70% passing score. In addition to the results of the written examination, 9% of the candidates failed to pass their psycho-motor skill evaluation. The results of the skill evaluation are not part of this actual study but may be of interest for future research. The age of the candidates ranged from eighteen to seventy years old. The median age of all candidates was thirty four years of age. Fifty two percent of the participants indicated they were high school graduates with an additional 29.2% identified as having two years or less of college. Sixty-five candidates (12.5%) indicated they completed at least four years of college. Tables 2-6 include descriptive statistics of all five-hundred nineteen participants. Demographics are provided in the following tables in order to provide the reader with a clear perspective of the candidate's backgrounds.

Table 2. Descriptive statistics of written examination results for the entire group

Group Studied	N	Mean	Standard deviation	Range score
All F/F I Candidates in Iowa	519	78.38%	9.13	40-95

Table 3.      Frequencies of candidates' position in fire service

Position	n	Percent of Total
Fire Fighter	367	70.7
Driver/Operator	68	13.1
Lowest Ranking Co. Off.	46	8.9
Highest Ranking Co. Off.	16	3.1
Training Officer	4	0.8
Inspector	4	0.8
Lowest Chief Level	9	1.7
Chief of Dept.	5	1.0

Table 4.      Frequencies of population categories the candidates protect

Size of Population	n	Percent of Total
Less than 199	1	.2
200-499	1	.2
500-999	14	2.7
1,000-2,459	35	6.7
2,500-4,999	31	6.0
5,000-9,999	89	17.1
10,000-24,999	79	15.2
25,000-99,999	86	16.6
100,000 & Over	183	35.3

Table 5.       Frequencies of education levels completed

Formal Education	n	Percent of Total
4 years	1	.2
7 years	1	.2
8 years	1	.2
10 years	1	.2
11 years	1	.2
12 years	270	52.0
13 years	76	14.6
14 years	76	14.6
15 years	27	5.2
16 years	65	12.5

Table 6.       Frequencies of test scores

Percent Correct	n	Percent of Total Candidates
40-59	16	3.1
60-69	61	11.7
70-79	184	35.5
80-89	215	41.5
90-95	43	8.3

## Hypothesis 1A

Hypothesis 1A concerned comparisons of three methods of structured learning against three methods of self-study. Each method (variable "k") was identified as belonging to the structured learning group or appropriate to be included in the self-study group. The three methods of instructor-led

preparation were: 1) Fire Service Institute course, 2) community college course, or 3) fire department training programs. These methods were grouped together as structured learning. The remaining three methods were: 1) IFSTA manuals, 2) IFSTA video tapes, or 3) other materials. These three methods were grouped together as self-study. The mean written test scores for both preparatory groupings were then compared. The mean of the structured learning group was 77.18 while the self-study group mean score was 80.23. Additional data illustrates that 89.2 % of the self-study group passed the examination while 82.1 % of the structured learning group achieved a passing score. Table 7 indicates the descriptive statistics of the two preparation groups.

Table 7. Descriptive statistics of written examination results for grouped preparation methods

Method of Preparation	n	Mean	Range Score	Percent of n with a passing score
Structured Learning	319	77.18	41-95	82.1
Self-Study	176	80.23	40-94	89.2

Hypothesis 1A stated that there would be no significant differences in Fire Fighter I written examination scores when comparing structured learning against self-study

preparation. The results of a t-test analysis, shown in Table 8 produced a t-value of -3.56 with the probability of 0.00, indicating a significant difference between the two groups. The hypothesis that there is no difference in structured learning and self-study was not supported. In fact, the self-study group scored significantly higher than those that prepared in a structured learning setting.

Table 8. T-test analysis of grouped preparation scores

Group	n	Mean	Standard deviation	t-value	2-tailed prob.
Structured	319	77.19	9.44	-3.56	.000
Self-Study	176	80.23	8.43		

#### Hypothesis 1B

Hypothesis 1B posits there will be a difference in test scores when all seven methods of preparation are compared. In order to identify whether any specific method of preparation resulted in a different mean score, a one-way analysis of variance was performed regardless of whether the method had been earlier grouped as structured or self-study. An unexpected result from such a large sample was the minimal number of respondents who indicated their primary method of preparation as either the use of video tapes or other material. Because of insufficient responses for these two

methods, video tapes and other material are not considered in the analyses. Further discussion of the potential implications regarding these two methods can be found in Chapter 5. Table 9 lists frequencies and mean scores for all seven categories of preparation.

Table 9. Descriptive statistics of written examination results by method of preparation

Method	n	% of total number of observations	Mean	Percent of n with a passing score
Comm. College	14	2.7	68.43	36
ISU-FSI Class	23	4.4	69.00	61
F.D. Training	282	54.3	78.30	86
IFSTA Manuals	170	32.8	80.59	89
Did Not Study	24	4.6	80.92	96
IFSTA Videos	4 <sup>a</sup>	0.8	n/a	n/a
Other Materials	2 <sup>a</sup>	0.4	n/a	n/a

<sup>a</sup>Less than acceptable sample size.

To identify any significant differences between the means of the five remaining methods, a one-way analysis of variance was conducted. As shown in Table 10, an F value of 14.89 was found with a probability of < .01.

Table 10. Analysis of variance on means of preparation methods to determine score differences

Source	df	Sum of squares	Means squares	F-ratio
Between groups	4	4,389.60	1,097.40	14.89**
Within groups	508	37,436.59	73.69	
TOTAL	512	41,826.19		

\*\* Probability <.01.

Statistical evidence indicates there is a difference among scores when comparing all five methods against each other. Results indicate scores on the Fire Fighter I exam are significantly different ( $p \leq .05$ ) based upon the specific method of preparation selected by the candidate.

To compare the mean differences of the five methods of preparation, a Tukey test of significance was used. This test is often referred to as the HSD (honestly significant difference) test. In order to illustrate which specific methods create a difference Table 11 was created.



Table 11. Tukey test results on method of preparation

METHOD	Community College	ISU-FSI	F.D. Training	IFSTA Manuals	Did Not Study
Community College					
ISU-FSI Course					
F.D. Training	*	*			
IFSTA Manuals	*	*	*		
Did Not Study	*	*			

\* denotes pairs of groups significantly different at the 0.05 level.

The preparation method of using IFSTA manuals created a statistically significant difference when compared to three other methods of preparation. Higher scores were achieved by those candidates using manuals to develop competency. Likewise candidates who prepared through the use of a fire department training program scored significantly higher than those candidates enrolled in a Fire Service Institute or community college course. An interesting result was also the fact that those indicated they did not study resulted in the highest mean score. In fact, those that did not study scored significantly higher than those candidates that prepared through Fire Service Institute or community college courses.

## Hypothesis 2A

Hypothesis 2A recognizes the number of years of experience in the fire fighting occupation as a basis for preparation and competency. It was proposed in Chapter 1 that there would be a difference in mean test scores when comparing the various categorical levels of experience. Candidates taking the Fire Fighter I examination resulted in a wide variety of experience levels. Table 12 identifies frequencies of all experience groups. Additionally, the percentage of each group obtaining a passing score of 70% or greater correct on the written examination is illustrated.

Table 12. Frequencies of experience levels of candidates taking the written examination

Years of Experience	n	Percent of N	Mean	Percent of n with a passing score
3-5 years	112	21.6	76.38	79
More than 25 years	19	3.7	77.74	90
1-2 years	96	18.5	77.77	74
6-9 years	61	11.8	78.15	85
16-25 years	54	10.4	78.52	85
Less than 1 year	89	17.5	79.43	91
10-15 years	86	16.6	81.81	97

In order to determine if there was a significant difference between the mean scores of the seven experience levels,

a one-way analysis of variance was conducted. As shown in Table 13, a F value of 4.46 was found with the probability <.01.

Table 13. Analysis of variance on group means of experience to determine score differences

Source	df	Sum of squares	Means squares	F-ratio
Between groups	6	2171.49	361.92	4.46**
Within groups	490	39722.27	81.07	
TOTAL	496	41893.76		

\*\* Probability <.01.

As predicted, there is a significant difference among scores when comparing experience levels against each other. To further investigate the results of Hypothesis 2A the means of the seven groups of experience levels were evaluated using a Tukey test of significance. The results are shown in Table 14. The group of candidates with ten to fifteen years of experience achieved a higher score than the candidates with one to two years and three to five years of experience. The group with less than one year as a fire fighter scored comparatively well. The two largest groups of candidates between one and five years of experience appeared to score the worst. It is very interesting that this group of experienced

fire fighters are not achieving competitive test results. These two groups, between one and five years, are also proportionately failing the examination more frequently when compared against the other groups. Twenty-six percent of the candidates with one to two years fails the exam while twenty-one percent of the candidates with three to five years fails. Only 9% of the candidates with less than one year, fails the examination. Hypothesis 2A, which stated that a significant difference would exist in Fire Fighter I written examination scores when compared with years of experience as a fire fighter is supported.

Table 14. Tukey test results on experience levels

EXP.	<1yr	1-2yrs	3-5yrs	6-9yrs	10-15yrs	16-25yrs	>25
< 1 yr.							
1-2 yrs							
3-5 yrs							
6-9 yrs							
10-15 yrs		*	*				
16-25 yrs							
> 25 yrs							

\* denotes pairs of groups significantly different at the 0.05 level.

## Hypothesis 3A

Hypothesis 3A projected a significant difference would exist in written examination scores between members of fully paid career departments and members of volunteer departments. Twenty-nine percent of the candidates were members of totally volunteer fire departments while 54.7% of the candidates were members of fully paid, career fire departments. Table 15 identifies the t-test results. A significant difference was found between the two fire department affiliations. Whether a candidate is a career firefighter or a volunteer fire fighter appears to be a factor in influencing scores on the examination. A comparison of the two means reveal that career fire fighter scores are significantly higher than volunteer fire fighters scores.

Table 15. T-test analysis of written examination score compared to fire department affiliation

Group	Number	Mean	Standard deviation	t-value	2-tailed probability
Career	284	82.14	7.11	11.58	0.00
Volunteer	154	72.66	8.71		
	<u>438</u>				

## Hypothesis 4A

Hypothesis 4A predicted no significant ( $p \leq .05$ ) difference on the Fire Fighter I written examination based on gender of the candidate. Only 3.5% of the fire fighter candidates taking the examination were female. Table 16 shows that gender of the respondent is not a factor in influencing examination scores. A comparison of the two means illustrate there was no significant difference between the scores of males and females. It may be worthy to note that only 18 females are represented in comparison with 501 males.

Table 16. T-test analysis of written examination score by gender

Group	n	Mean	Standard deviation	t-value	2-tailed probability
Male	501	78.40	9.19	.16	0.874
Female	18	78.06	8.48		
Total	<u>519</u>				

## Summary

This chapter presented the results of various statistical analyses. The mean scores of written examinations, as dependent variables, were compared against methods of preparation. Other variables investigated pertained to years

of experience, career vs. volunteer and male vs. female results.

A significant difference in scores was found between structured learning methods and the self-study methods. Those using self-study methods scored higher than the ones using structured learning methods. When each specific method of preparation was analyzed for significant differences, three methods resulted in statistical differences. Fire department training programs and the use of IFSTA manuals achieved higher scores than either Fire Service Institute or community college courses. Additionally, the use of IFSTA manuals created a higher score than those preparing through fire department training programs. Those candidates that indicated they did not study also scored higher than those using the Fire Service Institute or community college programs. Fire fighter candidates with ten to fifteen years of experience scored significantly higher than candidates with one to five years of experience. Career fire fighters scored significantly higher on the examination than volunteer fire fighters. An average of a 10% difference in score was based on this affiliation factor. The gender of the candidates did not reveal a difference in examination scores although far fewer females participated in the examination process than men.

## CHAPTER 5. CONCLUSIONS, IMPLICATIONS AND SUMMARY

### Introduction

The final chapter will present conclusions in terms of research questions posed in Chapter 1, discuss their implications and recommend further research. The chapter begins with a review of the study's purpose and ends with a summary of the possible significance derived from the study.

### Purpose of the Study

Occupational testing and certification are commonplace in many professions in the United States. With advancements in technology, new approaches to learning and developing competence have evolved. Video taped lessons, satellite training, interactive videos and computer assisted instruction are but a few of the alternatives to the traditional classroom setting. Andragogy as a science has begun to view specific ways that adults learn. Traditional instructor-led teaching has been challenged by alternatives including self-study. A more learner-centered approach is available in some disciplines through self-study, contract learning, self-pacing, self-directed or independent learning. The effectiveness of learner centered self-study compared to teacher-led structured learning has not been widely researched. Additionally, as in the fire service profession, there still appears to be a reluctance to allow alternatives to the



traditional classroom environment. In fact some state certifying agencies will only allow a fire fighter candidate to prove their competency after a lengthy mandatory class has been completed regardless of previous training or current competency.

The purpose of this study was to provide specific research toward evaluating preparatory methods of developing competence in order to become certified as an Iowa Fire Fighter I. Additional demographic data were collected and analyzed in hopes of discovering variables that contribute to developing competency and ultimately becoming certified as a fire fighter.

## Conclusions

### Methods of Preparation

In an effort to identify what preparatory methods are effective in developing competency, six potential methods were identified. These methods are commonly used in the fire service to develop competency toward certification. One reason for studying this issue is the apparent inequity in various state certifying agency's recognition of specific methods of preparation. Some certifying agencies (Cox, 1990) continue to ignore methods other than highly structured, instructor-led classroom courses as acceptable methods of preparation. Various authors (Brookfield, 1986; Darkenwald,

1982; Knowles, 1975; Wilson, 1979) identify the importance of student-centered approaches in adult learning. Based on whether a preparation method was instructor led or student centered, the six methods were organized into two groups of preparation. Structured learning was then compared to self-study learning by written examination scores. With a criterion-based, competency examination, test results were expected to reflect the effectiveness of preparation. The hypothesis that there was no difference was not supported in the statistical results. Candidates who prepared by using self-study methods scored significantly higher than those that participated in a structured learning environment. The results should cause those certifying agencies limiting their candidates to only structured learning to reexamine their policies and consider recognizing alternative methods of preparation. It is a possibility that the hypothesis was not supported by the fact that self-study is actually a better method to develop competency for occupational training. What causes the difference? Underlying variables could possibly have an impact on the difference found. The motivational aspect of choosing certain methods of preparation should be explored. It may be that those that participated in the structured learning sessions were mandated to attend and ultimately less motivated to develop competency. Some fire

departments require specific training and the fire fighter has little choice in the method chosen. Because the hypothesis actually indicates that self-study methods are better than initially proposed, the adult education approach to developing competency is strengthened. The issue of structured learning vs. self-study was devised for the potential benefit to a candidate and ultimately the certifying agencies. The results indicate that identifying alternative types of preparation may help guide the student toward useful preparatory methods.

Seven specific methods of preparation including Fire Service Institute courses, community college courses, fire department training, IFSTA manuals, IFSTA videos, other study materials and a category of did not study were analyzed individually. One surprising result was the low (less than five) number of respondents that identified the use of videos tapes or other materials. It is the author's experience that the marketing and purchase of video taped training material is widespread in the fire service. Complete volumes of tapes are available that assist an individual in learning material relevant to certification as a fire fighter. The category identified as other material was expected to attract those candidates who did not consider one of the other methods applicable to their approach. The power of the statistical analysis was insufficient based on such a small number of

respondents in these two categories. When conducting the one-way analysis of variance on the seven methods, video tapes and other material were thus excluded. Since these methods were not identified by the candidates as primary methods of preparation, what is their role in developing competency? As suggested later in this chapter, in the further research section, a follow-up survey or restructuring of the methods variable is in order to account for the inadequate response.

Surprisingly, candidates who identified they did not study for the test, although their total number was relatively small, achieved the highest mean score. A number of potential moderating variables could account for this difference in scores. Candidates who did not study were perhaps instructors who are very familiar with the cognitive material. Another reason for the result could be that the candidates were possibly from a fire department that naturally allows for daily reinforcement of fire fighter roles through on-the-job training. It is also possible that candidates who indicated they did not study were engaged in some activity or learning experience they did not interpret as training. Regardless, of the potential moderating variables, it is extremely interesting to note that candidates indicating they did not study achieved the highest mean score.

Fire department training programs, or the use of IFSTA manuals produced significantly higher test scores than the Fire Service Institute and community college courses. In order to fully understand the implications of this difference, each program would require investigation. Curriculum, length of training and availability of resources should be compared. It is interesting to note that the Fire Service Institute and community college programs have resulted in a mean test score below the passing score of 70. The number of subjects that prepared using the Fire Service Institute courses was proportionally low compared to manuals and fire department training programs. One reason may be the fact that the new course delivery has been in effect for less than two years and less than fifty people had completed the entire training necessary to develop enough competency to challenge the fire fighter examination. Additionally, the groups ranging between one and five years of experience were the groups that most often enrolled in the Fire Service Institute course. The same candidates, with one to five years of experience, characteristically scored low on the examination. Also, the potential motivational aspect must not be overlooked. Most students enrolled in a Fire Service Institute course are enrolled as a group by their fire department. Those students may have little choice in whether they attend. A relatively low number of subjects also indicated that their

main method of preparation was through the use of community college training. Prior to 1989, a major portion of Fire Fighter I training occurred at the community college level. Since that time the curriculum offerings at most community colleges in Iowa are now centered around speciality training such as hazardous materials and fire department administration. If test results of candidates previously enrolled in Fire Service Institute and community college courses remain low and the goal of preparation is to truly develop competency and ultimately become certified, each program may have to be improved in order to obtain the goal. Perhaps the effective aspects of self-study could be incorporated into a portion of these classes to improve their results. It may be possible that the classroom process being utilized by the instructor needs to be reexamined. Before drastic changes are made, further considerations should also be evaluated such as the time frames centered around the courses. Courses designed to develop competency at the Fire Fighter I level can be condensed into a brief period of training lasting approximately four months or stretched out for as long as four years. What impact does this have on competency development? How soon after course completion one challenges the examination may also have a bearing on test results.

The IFSTA manuals method resulted in a mean score of 80.59. The mean score obtained by those utilizing fire

department training programs was 78.29. With over eight hundred fire departments in the State of Iowa alone, there could be a potential wide diversity in the effectiveness of their training programs. This study analyzed only the combined mean score of the various programs. Preparing for cognitive aspects of certification and developing competency through the use of IFSTA manuals, or participating in fire department training programs appear most effective at this time. Other methods of preparation should be investigated for differences in which specific improvements could be made.

#### Years of Experience

As a means of preparation, the length of time fire fighters spend in their occupation before taking an occupational exam may have a bearing on their score. In order to determine if there was a difference between years of experience and test scores, a one-way analysis of variance was computed on seven categories of experience. Results indicated that there was a statistically significant difference between experience groups. Those with ten to fifteen years of experience score significantly higher than those with one to two years, and three to five years experience. This raises the questions of when fire fighters have developed the highest level of competency. It is interesting to ponder why this difference in experience and test

scores occurred. What makes the group with one to five years of experience so much different that the other groups, especially the group with ten to fifteen years of experience? Most fire departments have a one year probationary period for new fire fighters. Is it possible that once a fire fighter is no longer on probation, their motivational drive to do well on the certification examination is lessened or for some reason are they actually less competent than other groups? Additionally, since the group with one to five years of experience primarily enrolls in Fire Service Institute classes or self-study using manuals, it is possible that these two methods are not the type of training these fire fighters need.

One aspect of experience not controlled by this study is the type, frequency and quality of the experience. The experience of a ten year volunteer in rural Iowa may be different than the experience of a ten year career member of a metropolitan fire department. Another interesting result of the experience variable is the fairly even distribution of candidates across the range of experience. Comparing the extreme ends, seventy-seven candidates with more than fifteen years of experience took the exam compared to eighty-eight candidates with less than one year. Why are fire fighters with more than fifteen years of experience just now seeking certification? Is the cause peer pressure, legal issues or



simply a desire to enhance their occupational credibility? A potential motivating factor not to be overlooked is the fact that now the examination is competency based and no strict classroom attendance requirements are mandated. The access and availability to challenge the examination is now open to candidates who seek that particular challenge. Whatever the cause, the agencies that offer occupational testing and certification would be limiting their clientele by only marketing newly trained recruits for certification. There is obviously an interest in occupational testing by those people who have been in their profession for a while but for whatever reason did not previously seek certification.

#### Fire Department Affiliation

With experience levels resulting in a difference of scores, it is interesting to compare the candidates' fire department affiliations. Fully paid career fire department personnel normally work full-time in their occupation while volunteer fire fighters may have less time to devote toward acquiring knowledge and developing skills as a fire fighter. Results from testing hypothesis 3A indicated a significant difference between career and volunteer firefighters. In addition to scoring differently on the examination there was also a larger percentage of career fire fighters seeking

certification than volunteers. Career fire fighters comprised 54.7% of the candidates and achieved a mean score of 82.14%. Volunteer fire fighters totaled 29.7% of all applicants and resulted in a mean examination score of 72.66%. Although the majority of fire fighters in the State of Iowa are volunteers, fewer volunteers are seeking certification and successfully achieving certification once they take the examination. An evaluation of this difference in score results and interest in certification should be conducted further in order to better understand why the difference is occurring. In the meantime, training agencies should consider their programming priorities and consider how a candidate is affiliated with a fire department. Volunteers may need a different approach to training in order to develop better competency.

#### Gender

The final hypothesis evaluated, centered around the gender of the fire fighter candidates. Hypothesis 4A stated that no significant difference would be found with examination scores when comparing men and women. Only 3.5% of over five hundred certification candidates were women. Test results indicate that no significant difference exists between the males and females when taking the written examination for fire fighter certification. Although it appears

that women develop equal cognitive abilities related to fire fighting knowledge, we still need to accurately evaluate their ability to perform the psycho-motor aspect of the fire fighting profession. Administrators, recruiters and training officers should seriously consider their policies and behaviors toward promoting the fire service community as an equal opportunity occupation. If cities and towns across the United States are in fact in need of more volunteer fire fighters, steps should be taken to make sure that women have the opportunity to become a team member of the volunteer or career company.

#### Further Research

There are a number of potential questions and procedures for future researchers to consider regarding the topic of preparation for occupational testing. Additional issues, also the product of specifically evaluating fire fighters in the State of Iowa, may be of interest for other studies.

1. The issue of what method a candidate selects in order to prepare and develop competency is a complex question. First of all, why does one select one particular method over the other? Do they have a choice in the selection or are they limited by certain resources that happen to be available at the time? In post hoc interviews with the candidates, some stated that their method of preparation was really a

combination of various methods. If that is true, then what combinations of methods seem to develop the best competency? A recommendation to future researchers would be to consider altering the survey instrument to allow the candidates more choices in identifying their method of preparation and allowing a combination of methods to be identified if applicable.

2. Regarding the results of significant differences in scores based on the method of preparation, additional study should investigate why this difference occurred. Is there a curriculum weakness in any one program that could be corrected? Are there components of the self-study method that could be built into the structured learning setting in order to improve competency? The issue of what motivational factors may be affecting the method chosen should be explored. Are the candidates that are forced into certain methods different from those that choose their method freely?

3. Considering experience as a potential means of preparation, is there any relationship between the experience of the fire fighter and the method of developing competency? In other words, is it possible that fire fighters with ten years of experience obtain better results through self-study while new inexperienced candidates develop competency best through structured learning?

4. One potential factor that may have an impact on preparation is the quality and quantity of preparation. How much value does the individual place on developing the cognitive material? If a candidate concentrates more time and effort on the psycho-motor aspect of preparation, the cognitive portion may suffer. Is the quality of certain programs better than others? Quality is partially defined as the study material being directly related to what the certification criteria is evaluating. The importance of the instructor process in the classroom must not be ignored. Is the process that is utilized, grounded on how people learn?

4. Considering the differences found in volunteer scores and the scores of career personnel, are there underlying motivational variables not considered in this research? Is the difference partially or wholly attributed to experience? Is the affiliation question a regional phenomenon? Would the same results occur with fire fighters in the Northeastern United States where volunteer fire fighters are sometimes better equipped than career personnel? Researchers should attempt to identify specific important differences between career and volunteer fire fighters and then attempt to analyze those variables.

5. Another interesting question to consider would be what exactly constitutes an acceptable score? Seventy percent

correct currently reflects the mandated pass/no pass score but what score actually reflects competency? How do we know what performance is actually occurring on the job? Once someone is certified, do those people perform more effectively or safely than those that are not certified? Do people with higher scores make better fire fighters?

6. With results indicating no difference in cognitive ability between men and women, what about the psycho-motor aspect of fire fighting? Although women are able to score equally well on the written examination, it would seem appropriate to now compare their physical abilities.

#### Summary

The generalized categories of structured learning and self-study, as forms of preparation, resulted in significant differences in test scores. Specific methods used to develop competency also show some significant differences. The variable of experience illustrated differences in test scores. The affiliation based on career or volunteer association resulted in significant test score differences. There was no difference in scores between gender groups. Certifying agencies or occupations offering testing for their profession should reassess their policies toward recognizing and supporting various preparatory methods. Foundations of

modern adult education should be recognized as viable methods to develop competency. Highly structured, teacher-led instruction is only one method of developing competency. The results of this study strongly support the concept of learner-centered approaches to developing competency. If in fact, non-traditional methods of developing competency are effective then those programs must also be supported and recognized. As certifying agencies, educational institutes and fire departments strive to improve and provide methods to develop competence, the principles of adult education should be reflected in their planning. The positive effects of experience, freedom to select alternatives and the use of self-directed behavior were reflected in this study.

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## APPENDIX A

## INSTRUCTIONS FOR ENTERING PERSONAL DATA ON THE TEST ANSWER SHEET

The following questions concern information about you, the department you work with, and the size of area you protect. These answers will help us to better train and serve the fire fighters of Iowa. Any published research results will protect your individual identity and is based upon your voluntary submission of this data. Please use the area to the LEFT OF THE SOLID VERTICAL LINE on your answer sheet for these answers.

**NAME**

Please fill in your name: Last, First, and Middle Initial, leaving a space between each. Put only one letter per box and fill in the appropriate circle beneath each letter.

**SEX**

Fill in appropriate circle.

**GRADE**

Indicate number of years of formal education completed. If you have completed more than 16, fill in the circle marked "16". If you have earned a G.E.D. and have not completed any college, fill in the circle marked "12".

**BIRTHDATE**

Indicate month, day, and year and fill in the appropriate circle.

**IDENTIFICATION NUMBER (A - I)**

Write in social security number in boxes A - I using no blank spaces or dashes. Fill in appropriate circles.

Please enter answers to the following questions in the small boxes below the letter indicated and fill in the appropriate circle.

**J - last column of "identification number"**

Please indicate which of the following best describes your current position in the fire service.

- |                                    |                        |
|------------------------------------|------------------------|
| 0) Fire Fighter                    | 5) Inspector           |
| 1) Driver/Operator                 | 6) Brigade Leader      |
| 2) Lowest rank of company officer  | 7) Brigade Chief       |
| 3) Highest rank of company officer | 8) Lowest Chief level  |
| 4) Training Officer                | 9) Chief of Department |

**K - first column of section marked "special code"**

My primary method of preparation for this test was: (Choose only one)

- 0) I did not study for this test
- 1) Fire Service Institute (ISU) sponsored class
- 2) Community College sponsored class
- 3) Fire department training program
- 4) Self study using IFSTA manuals
- 5) Self study using IFSTA video tapes
- 6) Self study using materials other than IFSTA

**L - second column of section marked "special codes"**

My current fire service status is:

- 0) I am not currently active with any fire department
- 1) A member of an incipient industrial brigade but not a member of a municipal department
- 2) A member of an industrial structural brigade but not a member of a municipal department
- 3) A member of an incipient industrial brigade and also a member of a municipal department
- 4) A member of an industrial structural brigade and also a member of a municipal department
- 5) A member of a volunteer department
- 6) A volunteer member of a partial paid-department
- 7) A career member of a partial paid-department
- 8) A career member of a fully paid department

**M - third column of section marked "special codes"**

My total year(s) of fire service experience is:

- |                                      |                       |
|--------------------------------------|-----------------------|
| 0) No active fire service experience | 4) 6-9 years          |
| 1) Less than one year                | 5) 10-15 years        |
| 2) 1 - 2 years                       | 6) 16-25 years        |
| 3) 3 - 5 years                       | 7) More than 25 years |

**N - fourth column of section marked "special codes"**

Please indicate which of the following best describes your highest position in the fire service.

- |                                    |                        |
|------------------------------------|------------------------|
| 0) Fire Fighter                    | 5) Inspector           |
| 1) Driver/Operator                 | 6) Brigade Leader      |
| 2) Lowest rank of company officer  | 7) Brigade Chief       |
| 3) Highest rank of company officer | 8) Lowest Chief Level  |
| 4) Training Officer                | 8) Chief of Department |

**O - fifth column of section marked "special codes"**

What is the population in the area your fire department protects? (If you are on a fire brigade, indicate the number of people in the plant.)

- |                  |                         |
|------------------|-------------------------|
| 0) 0 - 199       | 5) 5,000 - 9,999        |
| 1) 200 - 499     | 6) 10,000 - 24,999      |
| 2) 500 - 999     | 7) 25,000 - 99,999      |
| 3) 1,000 - 2,499 | 8) 100,000 - 500,000    |
| 4) 2,500 - 4,999 | 9) Statewide population |

**P - last column of section marked "special codes"**

Indicate the first digit of the SERIAL number located on the cover sheet of your test booklet.